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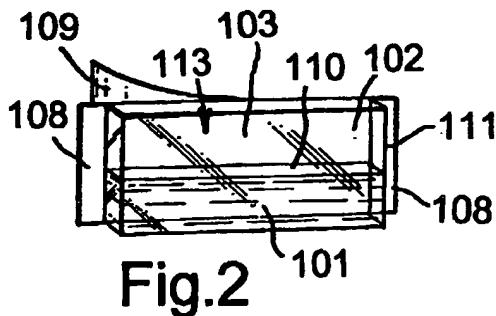
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(54) Abstract Title

Self adhesive and removable liquid-filled levelling device

(57) A disposable levelling device comprising a sealed housing (111) which is partially filled with liquid (101), wherein adhesive means, such as a layer of pressure sensitive adhesive, is provided to adhere the device to an object to be levelled. The top surface of the liquid inside the device indicates the horizontal. The device comprises one or more marker lines (200) which, when aligned with the top surface of the liquid, indicates that the device is correctly orientated relative to the horizontal. One or more non-adhesive tabs (108) are provided to enable easy removal of the levelling device after it has been adhered to a surface.



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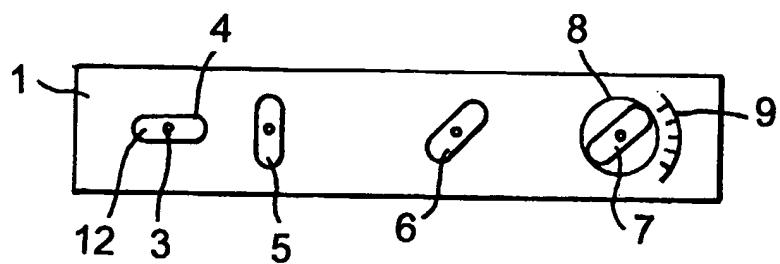


Fig. 1A

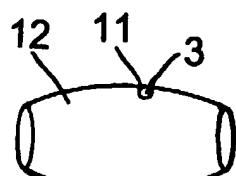


Fig. 1B



Fig. 3A

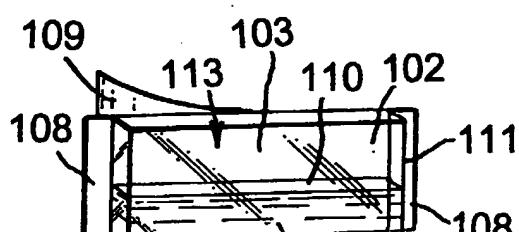


Fig. 2

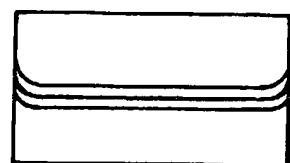


Fig. 3B

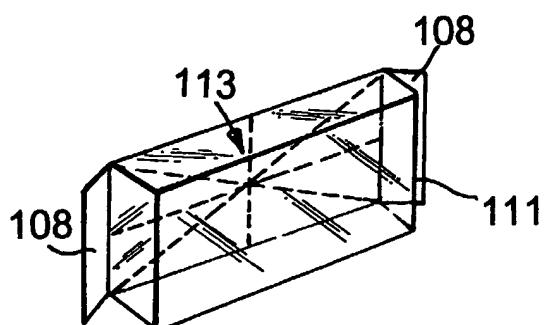


Fig. 3D

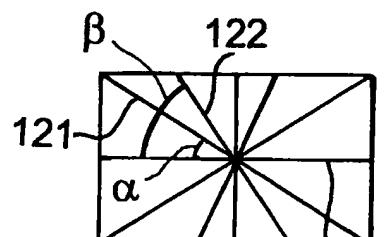


Fig. 3C

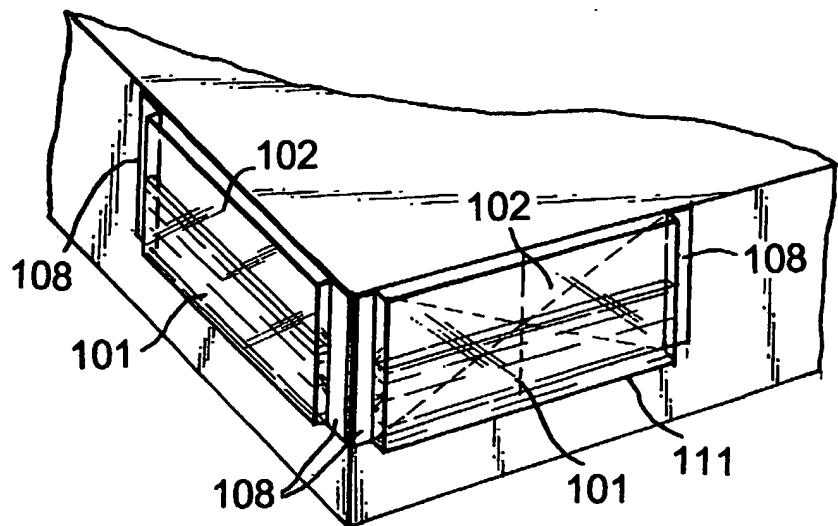


Fig. 4

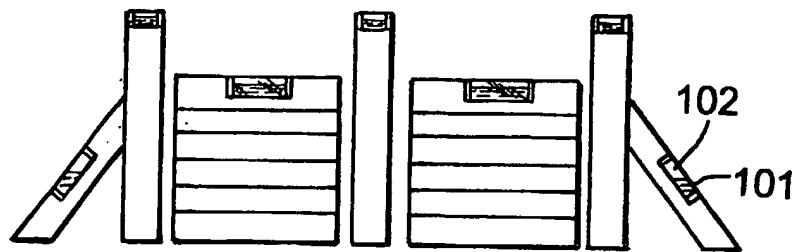


Fig. 5

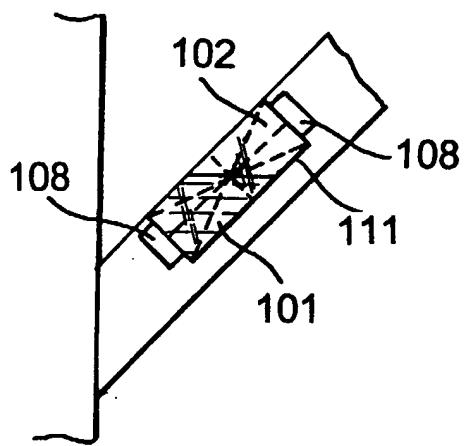


Fig. 6

## Liquid filled levelling device

This invention relates to a liquid filled levelling device, used, for example, to assist in the levelling of items such as shelves and fencing, prior to attaching them to a wall or post.

The idea of using a spirit level as a liquid filled levelling device is well known. A spirit level comprises a flat frame, in which one or more levelling devices are mounted. Each levelling device comprises a sealed glass tube nearly filled with alcohol or other liquid, containing an air bubble whose position is used to test for horizontality. The glass tube is slightly bowed, with a larger diameter at the centre than at the ends. The level's sensitivity is proportional to the radius of curvature along the length of the glass. Adjustment to the horizontal is indicated when the bubble is located in the middle of the glass, where the diameter is largest. Some spirit levels can measure 45° angles, by having an additional levelling device set at 45° to a flat edge of the frame. Some spirit levels can also measure any user-set angle, by having an additional levelling device set in a rotatable wheel, where an angular scale gives a reading of the angle, and the wheel is rotated to the required angle.

However, these currently known spirit levels suffer from several major disadvantages. They are large, bulky, and relatively heavy. They normally need to be held in place by hand during use, which may be inconvenient during the positioning and fixing of a heavy item such as a post. They also require space for storage. Magnetic spirit levels are also known previously, in which a magnet installed in the frame of the spirit level is used to hold the spirit level in position on the object to be levelled. However, these suffer from the disadvantage that they can only be attached to metallic objects, so would not be suitable for wooden shelving, posts and flat pack furniture.

Another problem with current spirit levels is that they can level on only one plane at a time. In order to level an object on a second plane, or in order to level a second object, the spirit level needs to be manually moved from one position to another. The person using the spirit level

may have their hands occupied by holding a heavy object, such as a shelf, in position, so their hands may not be free to move the spirit level. An alternative for levelling more than one object, would be to buy more than one spirit level, but this is relatively expensive, as well as being impractical, due to the necessity of holding each spirit level in place.

A first aspect of the present invention provides a levelling device comprising a sealed housing which is partially filled with liquid, wherein adhesive means are provided to adhere the device to an object to be levelled. Preferably, the adhesive means is a strip of pressure sensitive adhesive, such as double-sided sticky tape, and one or more non-adhesive tabs are provided to enable easy removal of the device after it has been adhered to a surface. The devices may be peeled off and discarded after use, or may be peeled off and re-used. Such a self adhesive levelling device could be used on flat pack, shelving, fence posts, or for other applications in the DIY sector. It could also be used in transportation, where goods have to be stored relatively upright or flat, for example in the transportation of electrical white goods. The levelling device would be easy to use, as it does not require to be manually held in position. It could be pre-fitted by the manufacturers of flat pack furniture, so that no positioning or installation would be required by the user. Alternatively, the levelling devices could be sold in the form of a strip or roll, in which the individual devices are attached to a single backing tape. The user could peel each device individually from the backing tape and attach it to an object to be levelled, as required. A tab could be provided on the peel-off backing, making it easier to peel off.

A further advantage of the present invention is that by varying the orientation of the device, the angle to be measured can be customised by the user. Angles other than just the horizontal could thus be tested for. When a non-standard angle is required, the user can accurately draw a pencil line at the required angle on the object, using a protractor. The edge of the levelling device can then be aligned with the pencil line. This has the advantage over a standard spirit level that it is difficult to hold a standard spirit level accurately in place along a pencil line. The cost would be much less than buying a specialist spirit level with a built-in rotatable levelling device.

Preferably, the front of the sealed housing of the levelling device is transparent, allowing the level of the liquid to be viewed. Preferably, the sealed housing is approximately half filled with liquid, and the means of finding the horizontal is by comparison with the level of the top surface of the liquid. In the preferred embodiment, the top surface of the liquid is used to indicate a horizontal direction only, although an alternative is to use the position of the top surface of the liquid to indicate a horizontal plane. Preferably, this horizontal direction is a direction parallel with the back or front face of the levelling device when the device has been levelled.

Preferably, the housing is made of plastic, although other materials, such as glass, could also be used. A suitable method of manufacturing the housing is by vacuum forming or moulding. Preferably, the liquid is alcohol, although other liquids, such as water could also be used. The meniscus of the liquid may be convex or concave, depending on the material used for the housing, and the liquid. It is preferable to use an arrangement which gives a minimal meniscus, because this will give a larger flat liquid surface over which to assess the alignment of the liquid level. The liquid could be coloured to make it easier to see its level.

As levelling devices are individually adhered to an object, there is no need for a large frame, as used in a currently known spirit level, and hence the levelling device of the invention is much smaller than a currently known spirit level. The construction of the device, as described, allows it to be made at very low cost. Each device can therefore be designed for a single use only, either being peeled off or left in place permanently after use.

A plurality of the devices could be used for levelling on more than one plane. Similarly, a plurality of the devices could be used for levelling more than one object, eliminating the need to move each device, such as when separate sections of fencing are used to construct a fence.

In a preferred embodiment of the invention, the housing is a cuboid shape, having flat rectangular faces. The device could be operated by fixing it onto an object to be aligned, such that the top and bottom edges of the device mark out the direction on the object which has to be aligned with the horizontal. The object is re-oriented such that the level of the liquid

becomes parallel with the top or bottom edge of the housing. The top and bottom edges of the device, and the required direction on the object, would then lie in a horizontal position.

Preferably the housing is labelled with one or more marker lines. The levelling device can be attached to an object to be levelled such that an edge of the device is aligned with an edge of the object. The marker lines are at the position at which the level of the liquid will be, when the device, and hence the object to be levelled, is in the required orientation. This makes it much easier to achieve precise alignment, than by comparing the liquid level with a top or bottom edge of the housing. Preferably, the marker lines are on the back face of the housing and may be seen through the transparent front face of the housing. The marker lines may be straight lines, or may be curved to coincide with the shape of the liquid meniscus when the device is level. The marker lines may be oriented parallel to the straight edges of the device, or may be set at a given angle. Marker lines set at a given angle would allow the object to be aligned in an orientation defined by that given angle. Marker lines could be present in several different orientations.

Other shapes of the housing are also possible, for example, a parallelepiped shape, wherein the back and front faces are oblique parallelograms. Another example is a shape in which a corner of the front face has an angle equal to the angle at which the object must be aligned, in order to make it easier to align an object at a given non-horizontal angle

If the device is misaligned along the direction perpendicular to the attachment surface, the apparent height of the liquid along the front face of the device may change noticeably. It becomes more difficult to read the device accurately when a marker line is not very close to the position of the meniscus. To remedy this problem, several parallel marker lines may be present, so that the nearest line to the liquid level can be chosen as a guide. However, by keeping the breadth of the housing small, this change in apparent liquid level can be minimised. An alternative to using a line as a marker is to use a two-colour scheme, whereby the region of the housing below the line position is of one colour, and the region above the line position is of another colour.

In an alternative embodiment of the invention, the device could be pinned or screwed onto an object, rather than adhered. It is also possible to include the described levelling device housing within a larger object or frame.

The levelling devices could be available in the form of a peel-off strip, peeling from a backing layer. The devices could be sold in rolls, where a roll comprises a rolled up strip of a backing layer, with a series of levelling devices attached, and ready to be peeled off and adhered.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a spirit level according to the prior art. Figure 1A shows how levelling devices can be positioned on the frame of a spirit level to measure the horizontal plane, 45° angles and user-set angles. Figure 1B shows how a bubble is used to determine alignment with the horizontal.

Figure 2 is a first embodiment of the invention, showing its shape, liquid level, tabs and peel-off backing.

Figure 3 shows levelling line arrangements in the invention. Figure 3A shows parallel levelling lines. Figure 3B shows levelling lines with a shape corresponding to the meniscus of the liquid. Figure 3C shows levelling lines at more than one angle. Figure 3D shows a perspective view of a levelling device housing, with levelling lines on the printed back.

Figure 4 shows an example of how the invention can be used to align an object along more than one orientation.

Figure 5 shows an example of how the invention can be used to align multiple objects, such as a series of fencing posts and panels.

Figure 6 shows how the invention can be used to align at angles other than the horizontal.

A standard spirit level, as known in the prior art, is shown in figure 1A. The spirit level has several levelling devices mounted in a flat frame (1). Two of the levelling devices (4, 5) test for the horizontal plane. A third levelling device (6) is set at 45°, to test for alignment of an object at 45°. A fourth levelling device (7) is set in a rotatable wheel (8), where the angle of the levelling device relative to the frame is measured by a scale (9), and can be selectively altered. The rotatable wheel (8) not only allows orienting of a device at a desired angle, but also allows the spirit level to be used to measure an unknown angle.

Figure 1B shows a levelling device of the spirit level of figure 1A in more detail. The levelling device comprises a bowed glass tube (10), in which the centre (11) of the tube (10) has a maximum diameter, and the ends of the tube (10) have a minimum diameter. The tube (10) is almost completely filled with a liquid (12), leaving a bubble (3) of air. When the device is in a level position, the central axis of the tube (10) will lie along the horizontal plane, and the bubble (3) will move to the centre (11) of the top of the tube (10). The curvature of the tube (10) along its length determines the sensitivity of the levelling device.

Figure 2 shows a first embodiment of the invention. The housing (111) of the levelling device has a cuboid shape, and is approximately half filled with liquid (101), and half filled with air (102). The front (103) of the device is made from a transparent material, in order to allow the level of the liquid to be viewed. The outside of the back face of the device is covered by a layer of pressure sensitive adhesive, which is protected by a peel off backing (109). This backing (109) is removed prior to adhering the levelling device to a surface. Unglued tabs (108) are provided at the sides of the device, to ease removal of the levelling device from an object, after the object has been aligned and secured in position. The liquid inside the device forms a flat upper surface (110), which indicates the horizontal.

The inner back face (113) of the device has a printed surface, on which marker lines are drawn for aiding the levelling process. Figures 3A to 3C show examples of sets of marker lines to be printed onto the inner back face. Figure 3A shows a series of horizontal marker lines. When the device is attached to an object to be aligned, rotation around axis A will affect the

levelling of the liquid relative to the marker lines. However, rotation around length axis B will change the apparent height of the liquid along the front face. The use of several parallel marker lines ensures that there will be a marker line very close to the position of the meniscus for any reasonable tilt about axis B, making reading of the device more accurate. A series of parallel lines also allows compensation for effects such as thermal expansion of the liquid inside the device.

A potential problem with the use of straight marker lines is that the curvature of the meniscus may significantly reduce the flat area on the top liquid surface, and only a fraction of the straight line will actually align with the liquid when the device is in a horizontal position. Figure 3B shows a set of marker lines which avoid this problem, by having a shape matching the expected shape of the meniscus when the device is levelled.

Figure 3C shows a device with marker lines in several orientations. The edge of the device is aligned along the edge of an object to be levelled. When the beam is at a  $0^\circ$  angle to the horizontal, the liquid will level parallel to line 120. When the beam is aligned at angle  $\alpha^\circ$  to the horizontal, the liquid will level parallel to line 121. When the beam is aligned at angle  $\beta^\circ$  to the horizontal, the liquid will level parallel to line 122. Thus, the device can be used to measure several angles, without having to unstick it, and re-attach it.

Figure 3D shows a perspective view of a levelling device with the marker lines as shown in figure 3C printed onto the inner back surface.

Figure 4 shows how two separate devices can be used to level over more than one orientation. The corner of a shelf is shown, and each vertical edge of the shelf is provided with a levelling device, allowing independent alignment of the shelf in each orientation

Figure 5 shows how multiple devices could be used in to align a set of fencing posts and panels, with one device attached to the front of each post or panel. A second device could be also be attached to the side of each fence post or panel, to ensure that the fence elements are not tilted backwards or forwards.

Figure 6 shows how the device can be used to align over a non-horizontal angle. The device is aligned along the edge of a beam, and the angle of the beam is adjusted until the upper surface of the liquid inside the device is aligned with a marker line at the appropriate angle.

**CLAIMS:**

- 1. A levelling device comprising a sealed housing which is partially filled with liquid, wherein adhesive means is provided to adhere the device to an object to be levelled.**
- 2. A levelling device, as claimed in claim 1, wherein the adhesive means is a layer of pressure sensitive adhesive.**
- 3. A levelling device, as claimed in claim 1 or 2, wherein one or more non-adhesive tabs are provided to enable easy removal of the levelling device after it has been adhered to a surface.**
- 4. A plurality of levelling devices, each levelling device as claimed in claims 1, 2 or 3, wherein the plurality of levelling devices are attached to a single backing tape, in the form of a strip or a roll.**
- 5. A levelling device comprising a sealed housing which is partially filled with liquid, wherein the top surface of the liquid inside the device indicates the horizontal.**
- 6. A levelling device as claimed in claim 1, 2 or 3, comprising a sealed housing which is partially filled with liquid, wherein the top surface of the liquid inside the device indicates the horizontal.**
- 7. A levelling device as claimed in claim 5 or 6, wherein a single direction along the top surface of the liquid inside the device is used to indicate the horizontal.**
- 8. A levelling device as claimed in claim 6 or 7, wherein the device comprises a marker line which, when aligned with the level of the liquid, indicates that the device is correctly orientated relative to the horizontal.**
- 9. A levelling device as claimed in any of claims 5 to 8, wherein more than one marker line is provided for aligning in a single orientation.**

10. A levelling device as claimed in any of claims 5 to 9, wherein marker lines are provided in more than one orientation, allowing the device to be aligned at more than one predetermined angle, each angle corresponding to the marker lines in a particular orientation.

11. A levelling device as claimed in claim 8, 9 or 10, wherein one or more of the marker lines are straight lines.

12. A levelling device as claimed in claim 8, 9 or 10, wherein one or more of the marker lines follow the shape of the meniscus of the liquid when the device is correctly orientated relative to the horizontal.

13. A levelling device as claimed in any of claims 5 to 12, wherein the shape of the device is a cuboid.

14. A levelling device as claimed in any of claims 5 to 12, wherein the shape of the device is a parallelepiped.

15. A levelling device comprising a sealed housing which is partially filled with liquid, wherein fastening means is provided to fasten the device to an object to be levelled.

16. A disposable levelling device.

17. A disposable levelling device comprising a sealed housing which is partially filled with liquid, wherein adhesive means are provided to adhere the device to an object to be levelled.

18. A method of aligning an object, or a multiple of objects, over more than one orientation or plane, using one or more individual levelling devices, the method comprising

for each orientation to which the object or objects must be aligned, adhering a levelling device to the object to be aligned, wherein the angle at which the levelling device is attached allows the liquid level to indicate when the device is in the desired orientation; and

adjusting the alignment of the object or objects until all levelling devices simultaneously show that the alignment of the object or objects is correct.

19. An item of flat pack furniture, fencing or shelving, to which a disposable levelling device according to any one of the previous claims has been attached.
20. An item for transportation in a particular orientation, to which a disposable levelling device according to any one of the previous claims has been attached.
21. A disposable levelling device comprising an elongate housing which is partially filled with liquid, the housing having a straight edge extending in the elongate direction and providing a guide for aligning the housing on an object to be levelled, and means on the housing for indicating when the object is levelled by reference to the surface of the liquid in the housing.



Application No: GB 0105110.1  
Claims searched: 1 - 15, 17, 18

Examiner: Tom Sutherland  
Date of search: 3 July 2002

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): G1F

Int Cl (Ed.7): G01C 9/26, 9/28, 9/34, 9/36

Other: Online: WPI, EPODOC, JAPIO

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2354963 A (HORNCastle) Page 3 line 33 to page 4 line 4.	1, 5 to 12, 15, 17, 18
X	EP 1046364 A (OLIVER MUÑOZ) See column 2 line 33.	1, 5 to 9, 17, 18
X	US 5463817 (LEEDS) See the Figs and col. 3 line 30 to col. 4 line 13.	1 to 3, 5 to 11, 13, 14, 15, 17, 18 at least.
X	US 4126944 (BURKHART) See column 2 lines 60 to 65.	1, 5 to 9, 15, 17, 18
X	US 4100681 (HOLLANDER) Whole document.	1 to 12, 15, 17, 18
X	FR 2788126 A (WALLEART) See the Figs., note page 5 line 17 to page 6 line 2 etc.	1 to 15, 17, 18
X	DE 29816908 U (KRACHT) See the Figs.	1, to 3, 5 to 12, 15, 17, 18

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.